



## ARPA-E's 37 Projects Selected From Funding Opportunity Announcement #1

**Project Title:** Direct Wafer: Enabling Terawatt Photovoltaics  
**Organization:** 1366 Technologies  
**Funding Amount:** \$4,000,000  
**Website:** [www.1366tech.com](http://www.1366tech.com)

### **Brief Description of Project**

For photovoltaics (PV) to reach terawatt scale and meet ARPA-E targets for energy generation, emissions reductions, and US jobs, three criteria must be met. PV devices must be: (1) low-cost ( $< \$0.80/\text{Wp}$ ); (2) made from abundant materials; and (3) high-efficiency ( $> 20\%$ ). Crystalline silicon is the only technology capable of meeting all three criteria. The single barrier limiting silicon's market penetration is the 35-year-old grand challenge of making high-efficiency wafers without the cost and waste of sawing.

1366 Technologies has developed a kerfless wafering process called Direct Wafer, which eliminates PV's cost and supply limitations, transforming PV from niche to mainstream. Direct Wafer slashes fully-installed PV system costs from  $\sim \$4/\text{W}$  to  $\sim \$2/\text{W}$  ( $\sim \$0.10/\text{kWh}$ ) and reduces wafer capital costs by 90%. By dramatically lowering cost, Direct Wafer could enable 600 GW of installed PV in the US by 2025, save 694 million metric tons of annual CO<sub>2</sub> emissions, and spawn a multi-million-job domestic PV manufacturing and installation industry.

### **Why ARPA-E Funding and Not Private Capital**

The cost and technical risk of Direct Wafer development makes the project unsuitable for private investment. The cost of going from laboratory setting to pilot production is large—driven by the need to process silicon at high temperatures while maintaining high purity and the need for state-of-the-art characterization to support the work. Private investors are also hesitant to invest in kerfless technologies due to numerous failed past attempts. This combination of a high-risk, high-payoff technology, a high cost of working with PV grade material, and the history of “almost-but-not-quite-successful” kerfless projects makes ARPA-E funding invaluable.

### **Uniqueness/Benefits of Technology**

Direct Wafer represents the key technical breakthrough in PV which could allow the US to reclaim silicon PV technical leadership and establish a strong US PV manufacturing industry. Much of the original silicon-based PV technology was developed in the US in the 1970s and 1980s, only to see it commercialized and standardized overseas. Ultimately, American leadership in energy can only be ensured with a strong silicon PV industry—no other PV technology combines the fundamentals of low cost, high efficiency, and earth-abundant feedstock to support large-scale impact.

### **Addressable Market & Potential Customers**

Direct Wafer technology has the potential to become the standard substrate for  $>80\%$  of the PV market. To meet global demand, we will build our own manufacturing facilities in the US and sell to hundreds of global customers. Direct Wafer's 80% cost reductions, low capital requirements, and compatibility with the existing supply chain will facilitate rapid commercialization. With a market growth rates of  $>30\%$  the potential market size will be  $\$17\text{bn}$  by 2015.

### **Key Team Member Bios**

#### Emanuel Sachs, CTO

Dr. Sachs is an MIT Professor with over 30 years of PV experience. Professor Sachs holds over 50 patents and has commercialized over  $\$1\text{bn}$  of new technologies, including String Ribbon, a PV technology which created over 3,000 jobs. Dr. Sachs received B.S., M.S., and Ph.D. degrees, all in Mechanical Engineering and all from MIT in 1975, 1976, and 1983, respectively.



For inquiries, contact:

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Website:

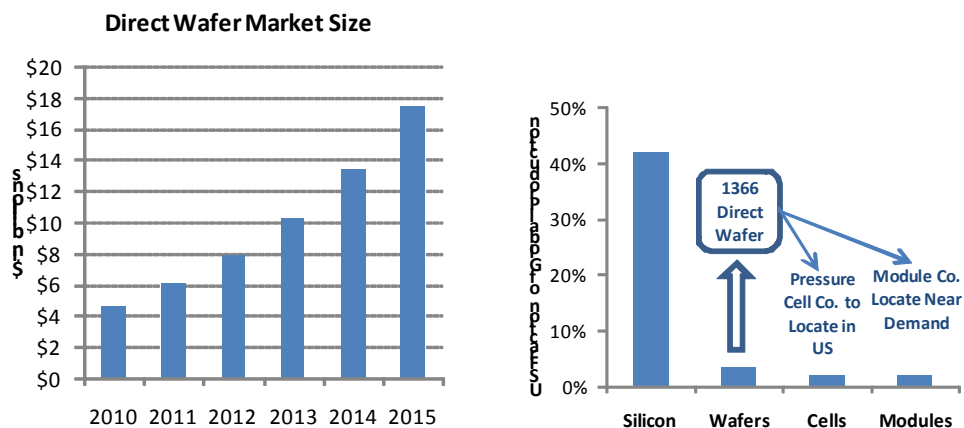
<http://arpa-e.energy.gov/>

Frank van Mierlo, President

Frank has over 20 years of experience in sales, marketing, business development and engineering at leading technology companies across the globe. Frank holds a Bachelor of Science in Mechanical Engineering from MIT, a Master of Science in Mechanical Engineering from Stanford and a Master of Business Administration from INSEAD.

**Testimonials**

1366 has been extremely impressed with the efficiency of the ARPA-E process and the professionalism of the staff. At 1366 Technologies we have been the recipient of three government contracts: a \$3M DOE Incubator, a \$500K DOE Pre-Incubator, and the \$4M ARPA-E award. The ARPA-E process, from submitting our application to signing the final contract took only 3.5 months, more than 4 times as fast as the normal DOE contracting process! The entire process was efficient and the staff, from the program manager to the lawyers to the contracting officers, was knowledgeable and helpful. The selection process was competitive and thorough. ARPA-E focused solely on the quality of the projects instead of specific areas of energy (quotas, etc). This revolutionary approach allowed them the freedom and flexibility to maximize the potential impact.

**Schematics/Photos of Technology or Personnel**

For inquiries, contact:

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